CLAIMS

What is claimed is:

1. A mixer comprises:

reference current source operably coupled to produce a reference current;

programmable gain radio frequency (RF) transconductance section operably coupled to convert an RF voltage into an RF current based on a gain setting signal and the reference current; and

switching quad transistors operably coupled to receive the RF current and a local oscillator voltage, wherein the switching quad transistors produce a frequency translated current.

2. The mixer of claim 1 further comprises:

current source pair operably coupled to provide DC current to the switching quad transistors;

common mode circuit operably coupled to provide a common mode voltage to the current source pair based on a common mode reference; and

resistor section operably coupled to switching quad transistors and to the current source pair to produce the common mode reference and to convert the frequency translated current into a frequency translated voltage.

3. The mixer of claim 1 further comprises:

current source pair operably coupled to provide DC current to the switching quad transistors;

common mode circuit operably coupled to provide a common mode voltage based on a common mode reference, wherein the common mode circuit includes:

resistive divider operably coupled to the switching quad transistors, wherein a tap of the resistive divider provides the common mode reference;

operational amplifier having inputs operably coupled to a reference voltage and to receive the common mode reference;

transistor pair operably driven by an output of the operational amplifier; and

resistor pair operably coupled to the transistor pair to provide an output of the mixer.

4. The mixer of claim 1 further comprises:

current source pair operably coupled to provide DC current to the switching quad transistors;

common mode circuit operably coupled to provide a common mode voltage based on a common mode reference, wherein the common mode circuit includes:

resistive divider operably coupled to the switching quad transistors, wherein a tap of the resistive divider provides the common mode reference;

second resistive divider operably coupled to the tap of the resistive divider to provide a scaled representation of the common mode reference;

operational amplifier having inputs operably coupled to a reference voltage and to receive the scaled representation of the common mode reference;

transistor pair operably driven by an output of the operational amplifier; and

resistor pair operably coupled to the transistor pair to provide an output of the mixer.

5. The mixer of claim 1 further comprises:

resistor section operably coupled to convert the frequency translated current into a frequency translated voltage.

6. The mixer of claim 1, wherein the programmable gain RF transconductance section further comprises:

RF input transistor pair operably coupled to receive the RF signal;

first tapped inductor operably coupled to the RF input transistor pair;

second tapped inductor operably coupled to the RF input transistor pair; and

selectable transistor section operably coupled to the first and second tapped inductors and to the reference current source, wherein, based a first state of the gain setting signal, the selectable transistor section couples the first and second tapped inductors to the reference current source to provide a first gain, and wherein, based on a second state of the gain setting signal, the selectable transistor section couples the first and second tapped inductors to the reference current source to provide a second gain.

7. The mixer of claim 1, wherein the programmable gain RF transconductance section further comprises:

RF input transistor pair operably coupled to receive the RF signal;

differential tapped inductor operably coupled to the RF input transistor pair; and

selectable transistor section operably coupled to the differential tapped inductor and to the reference current source, wherein, based a first state of the gain setting signal, the selectable transistor section couples the differential tapped inductor to the reference current source to provide a first gain, and wherein, based on a second state of the gain setting signal, the selectable transistor section couples the differential tapped

inductors to the reference current source to provide a second gain.

8. The mixer of claim 1, wherein the switching quad transistors further comprises:

native transistors operably coupled to produce the frequency translated current such that flicker noise of the mixer is reduced and gate to body voltage of the switching quad transistors is reduced.

9. A mixer comprises:

reference current source operably coupled to produce a reference current;

radio frequency (RF) transconductance section operably coupled to convert an RF voltage into an RF current based on the reference current; and

switching quad native transistors operably coupled to receive the RF current and a local oscillator voltage, wherein the switching quad native transistors produce a frequency translated current such that flicker noise of the mixer is reduced and gate to body voltage of the switching quad native transistors is reduced.

10. The mixer of claim 9, wherein the RF transconductance section further comprises:

RF input transistor pair operably coupled to receive the RF signal; and

inductor pair operably coupled to the RF input transistor pair, to the reference current source, and to the switching quad native transistors.

11. The mixer of claim 9 further comprises:

current source pair operably coupled to provide DC current to the switching quad native transistors;

common mode circuit operably coupled to provide a common mode voltage based on a common mode reference, wherein the common mode circuit includes:

common mode circuit operably coupled to provide a common mode voltage to the current source pair based on a common mode reference, wherein the common mode circuit includes:

at least one resistive divider operably coupled to the switching quad transistors, wherein a tap of the resistive divider provides the common mode reference;

second resistive divider operably coupled to the tap of the resistive divider to provide a scaled representation of the common mode reference;

operational amplifier having inputs operably coupled to a reference voltage and to receive the scaled representation of the common mode reference;

transistor pair operably driven by an output of the operational amplifier; and

resistor pair operably coupled to the transistor pair to provide an output of the mixer.

12. The mixer of claim 9 further comprises:

resistor section operably coupled to convert the frequency translated current into a frequency translated voltage.

13. The mixer of claim 9, wherein the RF transconductance section further comprises:

first tapped inductor;

second tapped inductor; and

selectable transistor section operably coupled to the first and second tapped inductors and to the reference current source, wherein, based a first state of the gain setting signal, the selectable transistor section couples the first and second tapped inductors to the reference current source to provide a first gain, and wherein, based on a second state of the gain setting signal, the selectable transistor section couples the first and second tapped inductors to the reference current source to provide a second gain.

14. A mixer comprises:

reference current source operably coupled to produce a reference current;

radio frequency (RF) transconductance section operably coupled to convert an RF voltage into an RF current based on the reference current;

switching quad transistors operably coupled to receive the RF current and a local oscillator voltage, wherein the switching quad transistors produce a frequency translated current;

current source pair operably coupled to provide DC current to the switching quad transistors; and

common mode circuit operably coupled to provide a common mode voltage based on a common mode reference, wherein the common mode circuit includes:

resistor section operably coupled to switching quad transistors and to the current source pair to produce the common mode reference and to convert the frequency translated current into a frequency translated voltage.

15. The mixer of claim 14, wherein the common mode circuit further comprise:

resistive divider operably coupled to the switching quad transistors, wherein a tap of the resistive divider provides the common mode reference;

operational amplifier having inputs operably coupled to a reference voltage and to receive the common mode reference;

transistor pair operably driven by an output of the operational amplifier; and

resistor pair operably coupled to the transistor pair to provide an output of the mixer.

16. The mixer of claim 14, wherein the common mode circuit further comprise:

resistive divider operably coupled to the switching quad transistors, wherein a tap of the resistive divider provides the common mode reference;

second resistive divider operably coupled to the tap of the resistive divider to provide a scaled representation of the common mode reference;

operational amplifier having inputs operably coupled to a reference voltage and to receive the scaled representation of the common mode reference;

transistor pair operably driven by an output of the operational amplifier; and

resistor pair operably coupled to the transistor pair to provide an output of the mixer.

17. The mixer of claim 14, wherein the RF transconductance section further comprises:

RF input transistor pair operably coupled to receive the RF signal;

first tapped inductor operably coupled to the RF input transistor pair;

second tapped inductor operably coupled to the RF input transistor pair; and

selectable transistor section operably coupled to the first and second tapped inductors and to the reference current source, wherein, based a first state of the gain setting signal, the selectable transistor section couples the first and second tapped inductors to the reference current source to provide a first gain, and wherein, based on a second state of the gain setting signal, the selectable transistor section couples the first and second tapped inductors to the reference current source to provide a second gain.

18. The mixer of claim 14, wherein the switching quad transistors further comprises:

native transistors operably coupled to produce the frequency translated current such that flicker noise of the mixer is reduced and gate to body voltage of the switching quad transistors is reduced.

19. The mixer of claim 14, wherein the RF transconductance section further comprises:

RF input transistor pair operably coupled to receive the RF signal;

inductor pair operably coupled to the RF input transistor pair, to the reference current source and to the switching quad native transistors.

20. An intermediate frequency (IF) module comprises:

local oscillator operably coupled to provide a local oscillation voltage;

first mixer operably coupled to mix an in-phase component of a signal with an in-phase component of the local oscillation voltage to produce an in-phase product;

second mixer operably coupled to mix a quadrature component of the signal with a quadrature component of the local oscillation voltage to produce a quadrature product, wherein each of the first and second mixers includes:

reference current source operably coupled to produce a reference current;

programmable gain radio frequency (RF) transconductance section operably coupled to convert voltage of the signal into current of the signal based on a gain setting signal and the reference current; and

switching quad transistors operably coupled to receive the current of the signal and the local oscillator voltage, wherein the switching quad transistors translate frequency of the current of the signal to produce the in-phase product and the quadrature product, respectively;

summing module operably coupled to sum the in-phase product and the quadrature product to produce a summed signal; and

filter module operably coupled to filter the summed signal to produce an IF signal.

21. The IF module of claim 20, wherein each of the first and second mixers further comprises:

current source pair operably coupled to provide DC current to the switching quad transistors;

common mode circuit operably coupled to provide a common mode voltage to the current source pair based on a common mode reference; and

resistor section operably coupled to switching quad transistors and to the current source pair to produce the common mode reference and to convert the frequency translated current into a frequency translated voltage.

22. The IF module of claim 20, wherein each of the first and second mixers further comprises:

resistor section operably coupled to convert the frequency translated current into a frequency translated voltage.

23. The IF module of claim 20, wherein the programmable gain RF transconductance section further comprises:

RF input transistor pair operably coupled to receive the RF signal;

first tapped inductor operably coupled to the RF input transistor pair;

second tapped inductor operably coupled to the RF input transistor pair; and

selectable transistor section operably coupled to the first and second tapped inductors and to the reference current source, wherein, based a first state of the gain setting signal, the selectable transistor section couples the first and second tapped inductors to the reference current source to provide a first gain, and wherein, based on a second state of the gain setting signal, the selectable transistor section couples the first and second tapped inductors to the reference current source to provide a second gain.

24. The IF module of claim 20, wherein the programmable gain RF transconductance section further comprises:

RF input transistor pair operably coupled to receive the RF signal;

differential tapped inductor operably coupled to the RF input transistor pair; and

selectable transistor section operably coupled to the differential tapped inductor and to the reference current source, wherein, based a first state of the gain setting signal, the selectable transistor section couples the differential tapped inductor to the reference current source to provide a first gain, and wherein, based on a second state of the gain setting signal, the selectable

transistor section couples the differential tapped inductors to the reference current source to provide a second gain.

25. The IF module of claim 20, wherein the switching quad transistors further comprises:

native transistors operably coupled to produce the frequency translated current such that flicker noise of the mixer is reduced and gate to body voltage of the switching quad transistors is reduced.

26. An intermediate frequency (IF) module comprises:

local oscillator operably coupled to provide a local oscillation voltage;

first mixer operably coupled to mix an in-phase component of a signal with an in-phase component of the local oscillation voltage to produce an in-phase product;

second mixer operably coupled to mix a quadrature component of the signal with a quadrature component of the local oscillation voltage to produce a quadrature product, wherein each of the first and second mixers includes:

reference current source operably coupled to produce a reference current;

radio frequency (RF) transconductance section operably coupled to convert a voltage of the signal into a current of the signal based on the reference current; and

switching quad native transistors operably coupled to receive the current of the signal and the local oscillator voltage, wherein the switching quad native transistors produce a frequency translated current as the in-phase produce and the quadrature product, respectively, such that flicker noise of the first and second mixers is reduced and gate to body voltage of the switching quad native transistors is reduced;

summing module operably coupled to sum the in-phase product and the quadrature product to produce a summed signal; and

filter module operably coupled to filter the summed signal to produce an IF signal.

27. The IF module of claim 26, wherein the RF transconductance section further comprises:

RF input transistor pair operably coupled to receive the RF signal;

inductor pair operably coupled to the RF input transistor pair, to the reference current source, and to the switching quad native transistors.

28. The IF module of claim 26, wherein each of the first and second mixers further comprises:

current source pair operably coupled to provide DC current to the switching quad native transistors;

common mode circuit operably coupled to provide a common mode voltage based on a common mode reference; and

resistor section operably coupled to switching quad native transistors and to the current source pair to produce the common mode reference and to convert the frequency translated current into a frequency translated voltage.

29. The IF module of claim 26, wherein each of the first and second mixers further comprises:

resistor section operably coupled to convert the frequency translated current into a frequency translated voltage.

30. The IF module of claim 26, wherein the RF transconductance section further comprises:

RF input transistor pair operably coupled to receive the RF signal;

first tapped inductor operably coupled to the RF input transistor pair;

second tapped inductor operably coupled to the RF input transistor pair; and

selectable transistor section operably coupled to the first and second tapped inductors and to the reference current source, wherein, based a first state of the gain setting signal, the selectable transistor section couples the first and second tapped inductors to the reference current source to provide a first gain, and wherein, based on a second state of the gain setting signal, the selectable transistor section couples the first and second tapped inductors to the reference current source to provide a second gain.

31. An intermediate frequency (IF) module comprises:

local oscillator operably coupled to provide a local oscillation voltage;

first mixer operably coupled to mix an in-phase component of a signal with an in-phase component of the local oscillation voltage to produce an in-phase product;

second mixer operably coupled to mix a quadrature component of the signal with a quadrature component of the local oscillation voltage to produce a quadrature product, wherein each of the first and second mixers includes:

reference current source operably coupled to produce a reference current;

radio frequency (RF) transconductance section operably coupled to convert a voltage of the signal into a current of the signal based on the reference current;

switching quad transistors operably coupled to receive the current of the signal and a local oscillator voltage, wherein the switching quad transistors produce a frequency translated current to represent the in-phase product and the quadrature product, respectively;

current source pair operably coupled to provide DC current to the switching quad transistors; and

common mode circuit operably coupled to provide a common mode voltage based on a common mode reference, wherein the common mode circuit includes:

resistor section operably coupled to switching quad transistors and to the current source pair to produce the common mode reference and to convert the frequency translated current into a frequency translated voltage;

summing module operably coupled to sum the in-phase product and the quadrature product to produce a summed signal; and

filter module operably coupled to filter the summed signal to produce an IF signal.

32. The IF module of claim 31, wherein the common mode circuit further comprise:

resistive divider operably coupled to the switching quad transistors, wherein a tap of the resistive divider provides the common mode reference;

operational amplifier having inputs operably coupled to a reference voltage and to receive the common mode reference;

transistor pair operably driven by an output of the operational amplifier; and

resistor pair operably coupled to the transistor pair to provide an output of the mixer.

33. The IF module of claim 31, wherein the common mode circuit further comprise:

resistive divider operably coupled to the switching quad transistors, wherein a tap of the resistive divider provides the common mode reference;

second resistive divider operably coupled to the tap of the resistive divider to provide a scaled representation of the common mode reference;

operational amplifier having inputs operably coupled to a reference voltage and to receive the scaled representation of the common mode reference;

transistor pair operably driven by an output of the operational amplifier; and

resistor pair operably coupled to the transistor pair to provide an output of the mixer.

34. The IF module of claim 31, wherein the RF transconductance section further comprises:

RF input transistor pair operably coupled to receive the RF signal;

first tapped inductor operably coupled to the RF input transistor pair;

second tapped inductor operably coupled to the RF input transistor pair; and

selectable transistor section operably coupled to the first and second tapped inductors and to the reference current source, wherein, based a first state of the gain setting signal, the selectable transistor section couples the first and second tapped inductors to the reference current source to provide a first gain, and wherein, based on a second state of the gain setting signal, the selectable transistor section couples the first and second tapped inductors to the reference current source to provide a second gain.

35. The IF module of claim 31, wherein the switching quad transistors further comprises:

native transistors operably coupled to produce the frequency translated current such that flicker noise of the mixer is reduced and gate to body voltage of the switching quad transistors is reduced.

36. The IF module of claim 31, wherein the RF transconductance section further comprises:

RF input transistor pair operably coupled to receive the RF signal; and

inductor pair operably coupled to the RF input transistor pair, to the reference current source and to the switching quad native transistors.